Earth Surface Processes and Landforms
Earth Surf. Process. Landforms **23**, 1141–1142 (1998)

SHORT COMMUNICATION

REPLY: DENUDATION RATES IN SOUTHEAST NORTHUMBERLAND SINCE THE DEVENSIAN GLACIATION

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Received 16 February 1998; Revised 2 July 1998; Accepted 4 July 1998

ABSTRACT

Undoubtedly the coastal till plateau of Northumberland was deeply incised by rivers crossing from the ice-covered uplands inland, and no doubt locally modified by subglacial drainage before the ice wasted back. Two approaches were used to allow for this in the measurement of the contribution of postglacial subaerial erosion to the shape of the contemporary landscape, and thus in the calculation of mean rates of erosion. If, despite these adjustments, the average depth of erosion has been overestimated. the error can be little more than 15 per cent. © 1998 John Wiley & Sons, Ltd.

KEY WORDS subaerial denudation; rate of erosion; till plateau

Clark claims that the landscape of the area mapped in figure 3 of Clayton (1997) owes more to the forms left by the melting Devensian ice than to normal dissection over the following 15 000 years or so. Whilst I do not agree with his conclusion, I accept entirely that subglacial incision and related changes as the ice melted away (which are no doubt in some places almost catastrophic in terms of the rate of change) have made a contribution to parts of this dissected landscape. It would have been easier to frame this reply had he ventured his own estimate of the changes that have occurred since deglaciation, and thus his estimate of the average rate of erosion over that time.

Reference to table III of Clayton 1997, (p. 728) will show that the data from the whole area (column 1) give a maximum depth of incision over the past 15 000 years or so of 47·1 m and a mean of 11·85 m, giving an averaged rate for denudation of 790 Bubnoff units (B). As the accompanying text explains, for the reasons he lists, and also because the major rivers rise off the till surface, I rejected these values as unrepresentative. The small catchment entirely on till (column 2) shows values for incision below the reconstructed till surface of 18·4 m maximum and an average of 4·3 m, giving a rate of 287 B. However, small catchments have small discharges and incise less rapidly than larger streams. For this reason the small Northumberland catchment was compared with the upper part of the Roding valley in Essex which has a smaller mean depth of erosion than the whole area; this adjustment increases the average depth of erosion for larger catchments to about 7·9 m.

Virtually the same value is achieved if the deeper gorges (i.e. all depths over 22 m) are eliminated for the reasons which Clark puts forward. Thus I regard the value of 520 B (Clayton, 1997, table III, column 3) as a very reasonable average for this landscape since deglaciation, though there can be little doubt that the rate was higher immediately following deglaciation and by today has no doubt fallen to something close to the long-term Suffolk value of 48·4 B.

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CCC 0197-9337/98/121141–02 $17.50

The major river gorges show evidence of partial or complete infilling by fluvioglacial sediment which has largely been re-excavated: the valleys are wider than at deglaciation, if not always deeper. In other areas there are older gorges, possibly subglacial, possibly interglacial in origin, now infilled by till and other glacial sediments. The erosion I quantify in the final column of table III (Clayton, 1997) has in part exhumed an older landscape; elsewhere it has still to erode enough of the Devensian sediments to discover the buried valleys. At a larger scale, the glacial deposits incompletely shroud a cuesta and vale landscape developed on Carboniferous rocks, as Clark's figure 1 shows. None of this denies the reality of postglacial denudation which I have quantified.

As neither Clark nor I were around to view the landforms as the Devensian ice melted, we both rely on comparisons with glacier forefields today. Some features of the landscape match young landforms of such areas, but most are either greatly subdued by subsequent slope processes, or are recognized in sections exposed as a result of later dissection. The main-line railway crosses several deeply incised valleys which have cut down through the till and grade to present-day sea level, itself suggesting cutting back from the coast and adjustments to a base level which has existed for no more than 6000 years. Finally, consideration of the deeply incised system of the Tyne and its tributaries shows a pattern that reflects the varying discharge and hence valley dimensions so neatly, both north and south of the main river, that it is surely linked to the pattern of discharges of the present drainage basins, with no appreciable legacy from subglacial or glacial marginal changes.

I believe the published paper (Clayton, 1997) makes adequate allowance for subglacial incision in the change between columns 1 and 3 of table III. If the approach has overestimated the average depth of erosion, the amount can only be small, say no more than 15 per cent.

REFERENCE

Clayton, K. M. 1997. 'The rate of denudation of some British lowland landscapes', *Earth Surface Processes and Landforms*, **22**, 721–731.

